

Claims

1. A molecular timetable generating apparatus for estimating internal biological time of a biological individual on the basis of gene product quantity data as measured in standard specimens sampled from individuals, the apparatus being characterized by comprising:

data input means for inputting gene product quantity data of standard specimens each sampled from a predetermined portion of each of a plurality of individuals of a predetermined biological species;

circadian oscillatory gene selection means for selecting, from among the genes which are expressed in the aforementioned standard specimens, circadian oscillatory genes whose time-course change in gene product quantity data approximates a cosine curve having a predetermined period;

circadian expression curve selection means for selecting, from among a plurality of cosine curves having different phases and sharing a specific period, a circadian expression curve which is similar to the pattern of time-course change in the expression product quantity of each of the above-selected circadian oscillatory genes; and

registration means for registering information which identifies the selected circadian expression curve.

2. The molecular timetable generating apparatus as recited in claim 1, characterized in that the registration means is configured so as to register, as a standard molecular time of the circadian oscillatory gene, a point in

time at which the circadian expression curve reaches the maximum, in the molecular timetable used for estimating the internal biological time, and also to register, in the molecular timetable, an average value and standard deviation, both calculated for each circadian oscillatory gene, of the expression product quantity data, as a standard expression quantity and standard variation of the circadian oscillatory gene, respectively.

3. An internal biological time estimation apparatus for estimating internal biological time of a biological individual on the basis of gene product quantity data as measured in specimens sampled from individuals, the apparatus comprising:

molecular timetable storage means for storing molecular timetables each of which specifies a circadian expression curve showing time-course change in the expression product quantity of a circadian oscillatory gene contained in a predetermined portion of a predetermined biological species;

data input means for inputting the gene product quantity data of the circadian oscillatory genes contained in a specimen sampled from said predetermined portion of the biological individual; and

internal biological time derivation means for obtaining internal biological time information including judgment as to whether or not the biological individual suffers a circadian rhythm disorder, and when the biological individual does not suffer a circadian rhythm disorder, an estimated internal

biological time of the biological individual, through comparison between the input measurement data and the circadian expression curve specified by the molecular timetable.

4. A molecular timetable generating method which enables, by use of information processing equipment, generation of a molecular timetable for estimating internal biological time of a biological individual on the basis of gene product quantity data as measured in standard specimens sampled from individuals, the method comprising:

a data input procedure for inputting gene product quantity data of standard specimens each sampled from a predetermined portion of each of a plurality of individuals of a predetermined biological species;

a circadian oscillatory gene selection procedure for selecting, from among the genes which are expressed in the aforementioned standard specimens, circadian oscillatory genes whose time-course change in gene product quantity data approximates a cosine curve having a predetermined period;

a circadian expression curve selection procedure for selecting, from among a plurality of cosine curves having different phases and sharing a specific period, a circadian expression curve which is similar to the pattern of time-course change in the expression product quantity of each of the above-selected circadian oscillatory genes; and

a registration procedure for registering information which identifies the selected circadian expression curve.

5. An internal biological time estimation method for estimating, by use of information processing equipment, internal biological time of a biological individual on the basis of gene product quantity data as measured in specimens sampled from individuals, the method being characterized by comprising:

a molecular timetable storage procedure for storing molecular timetables each of which specifies a circadian expression curve showing time-course change in the expression product quantity of a circadian oscillatory gene contained in a predetermined portion of a predetermined biological species;

a data input procedure for inputting the gene product quantity data of the circadian oscillatory genes contained in a specimen sampled from said predetermined portion of the biological individual; and

an internal biological time derivation procedure for obtaining internal biological time information including judgment as to whether or not the biological individual suffers a circadian rhythm disorder, and when the biological individual does not suffer a circadian rhythm disorder, an estimated internal biological time of the biological individual, through comparison between the input measurement data and the circadian expression curve specified by the molecular timetable.

6. A molecular timetable generating program which enables information processing equipment to perform:

a data input procedure for inputting gene product quantity data of standard specimens each sampled from a predetermined portion of each of a plurality of individuals of a predetermined biological species;

a circadian oscillatory gene selection procedure for selecting, from among the genes which are expressed in the aforementioned standard specimens, circadian oscillatory genes whose time-course change in gene product quantity data approximates a cosine curve having a predetermined period;

a circadian expression curve selection procedure for selecting, from among a plurality of cosine curves having different phases and sharing a specific period, a circadian expression curve which is similar to the pattern of time-course change in the expression product quantity of each of the above-selected circadian oscillatory genes; and

a registration procedure for registering information which identifies the selected circadian expression curve;

said information processing equipment being provided for generation of a molecular timetable for estimating internal biological time of the biological individual on the basis of gene product quantity data as measured in standard specimens sampled from individuals.

7. An internal biological time estimation program which enables information processing equipment to perform:

a molecular timetable storage procedure for storing molecular timetables each of which specifies a circadian expression curve showing time-course change in the expression

product quantity of a circadian oscillatory gene contained in a predetermined portion of a predetermined biological species;

a data input procedure for inputting the gene product quantity data of the circadian oscillatory genes contained in a specimen sampled from said predetermined portion of the biological individual; and

an internal biological time derivation procedure for obtaining internal biological time information including judgment as to whether or not the biological individual suffers a circadian rhythm disorder, and when the biological individual does not suffer a circadian rhythm disorder, an estimated internal biological time of the biological individual, through comparison between the input measurement data and the circadian expression curve specified by the molecular timetable;

said information processing equipment being provided for estimating internal biological time of the biological individual on the basis of gene product quantity data as measured in standard specimens sampled from individuals.

8. An internal biological time estimation system which enables generation of a molecular timetable for estimating internal biological time of a biological individual on the basis of gene product quantity data as measured in standard specimens sampled from individuals and estimation of internal biological time of the biological individual on the basis of gene product quantity data as measured in a specimen sampled

from the biological individual; said system being characterized by comprising:

a server computer installed in an information center for providing internal biological time information, and

a terminal computer connected to the server computer so as to transmit and receive information therebetween,

wherein the server computer includes:

standard data input means for inputting gene product quantity data of standard specimens each sampled from a predetermined portion of each of a plurality of individuals of a predetermined biological species;

circadian oscillatory gene selection means for selecting, from among the genes which are expressed in the aforementioned standard specimens, circadian oscillatory genes whose time-course change in gene product quantity data approximates a cosine curve having a predetermined period;

circadian expression curve selection means for selecting, from among a plurality of cosine curves having different phases and sharing a specific period, a circadian expression curve which is similar to the pattern of time-course change in the expression product quantity of each of the above-selected circadian oscillatory genes;

registration means for registering, as a standard molecular time of the circadian oscillatory gene, a point in time at which the circadian expression curve reaches the maximum, in the molecular timetable used for estimating the internal biological time, and also for registering, in the

molecular timetable, an average value and standard deviation, both calculated for each circadian oscillatory gene, of the expression product quantity data, as a standard expression quantity and standard variation of the circadian oscillatory gene, respectively;

measurement data input means for inputting the gene product quantity data of the circadian oscillatory genes contained in the specimen sampled from the said predetermined portion of the biological individual;

internal biological time derivation means for obtaining internal biological time information including judgment as to whether or not the biological individual suffers a circadian rhythm disorder, and when the biological individual does not suffer a circadian rhythm disorder, an estimated internal biological time of the biological individual, through comparison between the input measurement data and the circadian expression curve specified by the molecular timetable; and

internal biological time transmission means for transmitting the obtained internal biological time information to the terminal computer.